DDF annual report

Title of Investigation:

Control Center in the Classroom

Principal Investigator:

Ben Lui (Code 870)

Other In-house Members of Team:

Pat Hennessy (Code 584)

External Collaborators:

None

Initiation Year:

2004

Aggregate Amount of Funding Authorized in FY 2004 and Earlier Years:

$30,000

Funding Authorized for FY 2005:

$25,000

Actual or Expected Expenditure of FY 2005 Funding: Contracts:

$25,000 to Swales Aerospace

Status of Investigation at End of FY 2005:

This is an extension DDF project. Besides the baseline capabilities we developed in FY 2004, we have expanded our capabilities and added additional features to the system this year. Between FY 2004 and FY 2005, Control Center in the Classroom has supported nine educational flight missions. This capability will continue to be used to support future educational missions. Enhancements will continue to be made to the system.

Expected Completion Date:

December 2005

Purpose of Investigation:

The Educational Flight Projects Office (EFPO) has routinely provided flight opportunities to students who want to fly their experiments on scientific balloons and sounding rockets. Through these valuable, yet limited flight opportunities, EFPO has reached thousands of students over the years. While greater ingenuity has allowed us to reach more students per flight using these carrier systems, we realize that we can further expand participation.

The goal of this investigation is to inspire and excite large numbers of students by providing them with "hands-on" opportunities to control and monitor flight experiments in their classrooms. The project is to develop a Web-based system that can distribute launch and onboard video, flight telemetry, and ground-tracking data over the Internet. Through the system, hundreds and even thousands of students can monitor flight experiments and, in some cases, control them over the Internet.

Accomplishments to Date:

In FY 2004, we developed the baseline system to allow students to support educational flight missions over the Internet. The baseline system includes the follow features:

- Database-driven telemetry ingest and dissemination
- Web-based telemetry plotting
- Live Webcast of launch and onboard video
- Post-mission video and telemetry playback

In FY 2005, we enhanced the system by adding these crucial features:

- Commanding over the Internet
- Tracking map
- Access scheduling

Commanding over the Internet

Certain experiments require real-time commanding capability. For instance, Cosmo Cam is a scientific balloon experiment that carries two onboard instruments: a camera and a telescope. The instruments were designed to be controlled from the ground in real time. With the new commanding feature, students can now control (zoom, tilt, and pan) the camera and the telescope directly from their classrooms over the Internet. The corresponding videos can be delivered to the classroom in near-real time.

Figure 1 depicts the user interface of Control Center in the Classroom supporting the Cosmo Cam flight.

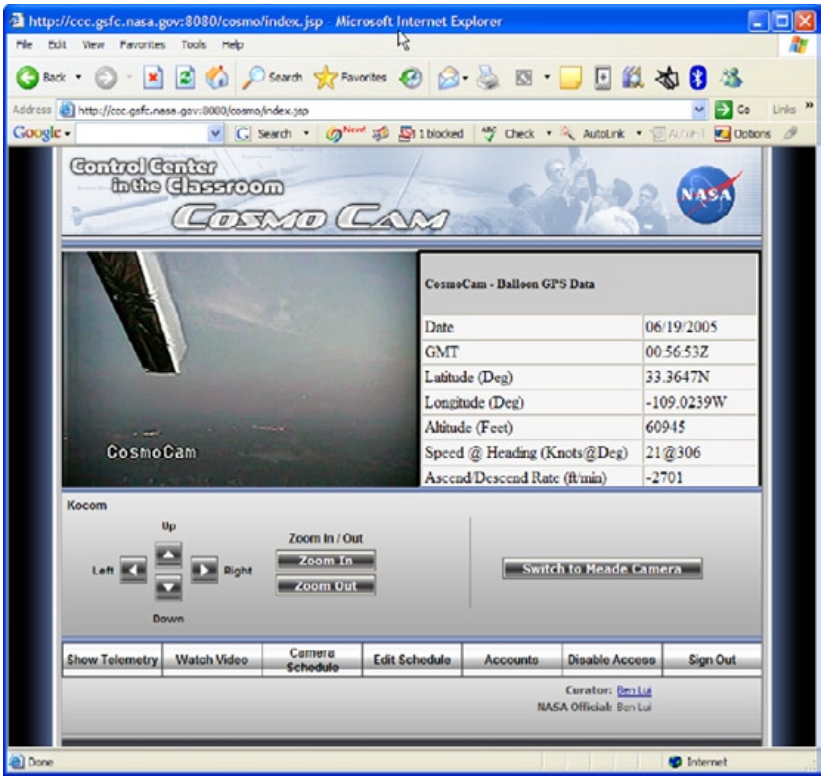

Figure 1. Control Center in the Classroom with commanding

Tracking Map

Tracking Map provides users with a live view of the flight path. Based on the real-time telemetry (longitude and latitude), the system continuously updates the flight path on the map. Users can adjust the viewing of the map with zoom in, zoom out, satellite image, regular map, or hybrid (a regular map overlaying a satellite image) controls. This visual feature offers students a better understanding of the experiment's geographic location corresponding to the flight data.

Tracking Map uses the Google Map API function, which is a free online feature provided by Google.

Figure 2 depicts the project's Tracking Map feature while supporting a sounding rocket flight called Sub-SEM.

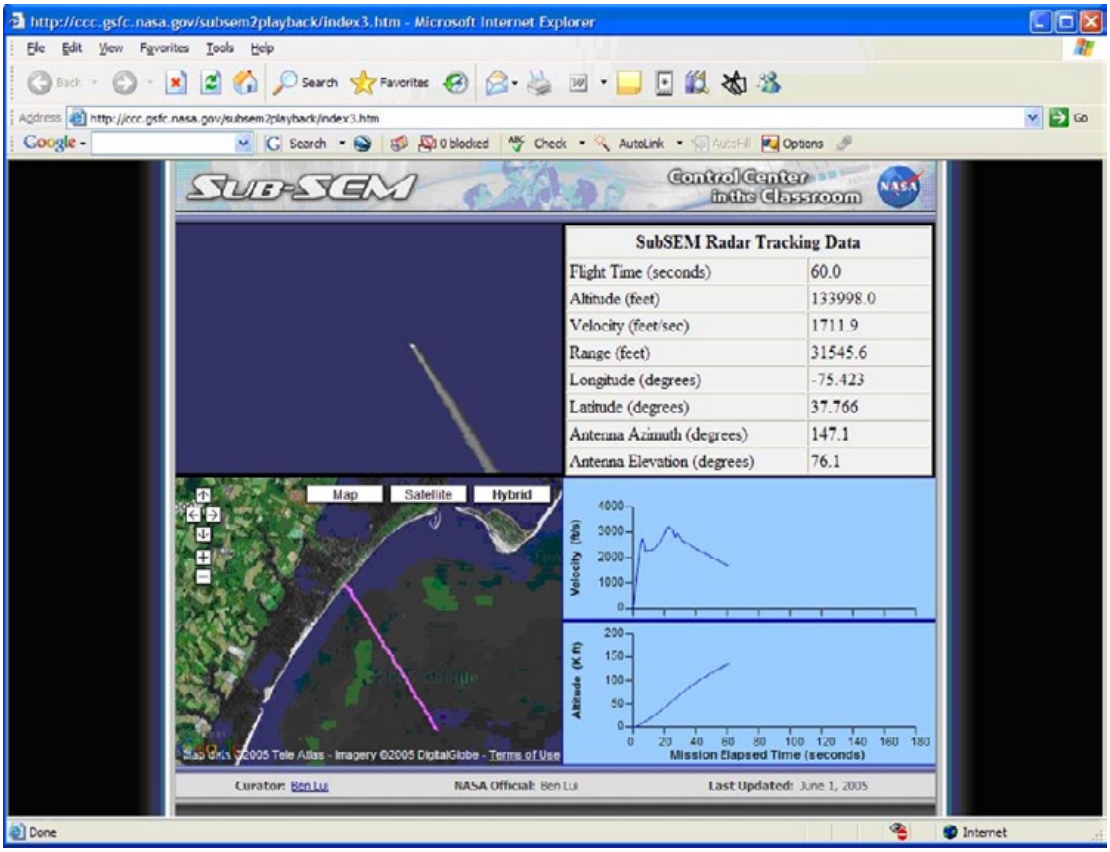

Figure 2. Control Center in the Classroom with Tracking Map

Access Scheduling

Access Scheduling is a management tool that allows many groups of students to share control of the experiment. This feature manages a timeline of when command access is granted to groups of students at different times. Based on the pre-defined timeline, each group of the students is given a time slot to control the experiment. When the time expires, Access Scheduling will terminate the access and give control to the next group.

In addition to the three new features, we also enhanced the Web-based plotting capability by using a more reliable Javascript approach instead of the previous applet approach. This enhancement not only provides us a more reliable plotting capability, but also multiple simultaneous plots (e.g. altitude vs. time and temperature vs. time). This becomes a very valuable learning tool because students can now see the relationship of altitude and temperature vs. time, for instance.

With the new and enhanced features, we supported several educational fights in 2005:

- Cosmo Cam, Feb 11
- SEMsonde, March 15
- Cosmo Cam, May 9
- Sub-SEM, June 9

- SEM-B, June 18
- SERI, July 21
- SEMsonde, Oct 27

Planned Future Work:

Transmitting commands across the Internet securely and reliably is one of NASA's top requirements. We are planning to enable the Secure Socket Layer (SSL) service on our system to protect data transmission across the Internet.

We also are looking into adding a real-time modeling capability to enhance the system's visual display. The real-time modeling will provide a computer generated 3-D graphic of the launch vehicle and its orientation for the entire flight.

Key Points Summary:

Project's innovative features: In the past, most educational flight projects required students to travel to the NASA control centers to support flight missions. Traveling prevented many students from participating in mission operations due to travel expenses and schedule conflicts. Control Center in the Classroom, an Internet-based control center, lets students be directly involved with their flight projects because it removes geographical limitations. Control Center in the Classroom brings the operations environment into the classroom. In addition, access to multiple users fosters partnerships, data sharing, and removes limits on the potential amount of direct student involvement. The capability creates the possibility of real-time student co-investigation during any NASA mission. Control Center in the Classroom also enables parents and the community to follow their children's accomplishments.

Potential payoff to Goddard/NASA: The payoff to NASA is that we can now more cost effectively reach students and the educational community.

The criteria for success: Providing hands-on opportunities to large numbers of students who participate in flight missions and inspiring and exciting them to get interested in science and technology are the criteria for success. The past two years' efforts have demonstrated the viability of integrating various technologies in a Web-accessible format for widespread distribution. Test audiences also have indicated that this is an effective tool for garnering interest and enthusiasm in NASA's space missions.

Technical risk factors: Some of the technical risks associated with this project include: (1) synchronizing video Webcasts and telemetry distribution in near real-time; and (2) supporting extremely large audience simultaneously. The first technical challenge involves a large amount of resources, and thus is out of the scope of this investigation. The second technical challenge can be resolved using a commercial company to host the Web-based distribution.